

Study Habits and Level of Difficulty Encountered by Maltese Students Studying Biology Advanced Level Topics

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Abstract—This research was performed to investigate the study habits and level of difficulty perceived by post-secondary students in Biology at Advanced-level topics after completing their first year of study. At the end of a two-year 'sixth form' course, Maltese students sit for the Matriculation and Secondary Education Certificate (MATSEC) Advanced-level biology exam as a requirement to pursue science-related studies at the University of Malta. The sample was composed of 23 students (16 taking Chemistry and seven taking some 'Other' subject at the Advanced Level). The cohort comprised seven males and 16 females. A questionnaire constructed by the authors, was answered anonymously during the last lecture at the end of the first year of study, in May 2016. The Chi square test revealed that gender plays no effect on the various study habits ($\chi^2(6) = 5.873$, $p = 0.438$). 'Reading both notes and textbooks' was the most common method adopted by males (71.4%), whereas 'Writing notes on each topic' was that mostly used by females (81.3%). The Mann-Whitney U test showed no significant difference in the study habits of students and the mean assessment mark obtained at the end of the first year course ($p = 0.231$). Statistical difference was found with the One-ANOVA test when comparing the mean assessment mark obtained at the end of the first year course when students are clustered by their Secondary Education Certificate (SEC) grade ($p < 0.001$). Those obtaining a SEC grade of 2 and 3 got the highest mean assessment of 68.33% and 66.9%, respectively [SEC grading is 1-7, where 1 is the highest]. The Friedman test was used to compare the mean difficulty rating scores provided for the difficulty of each topic. The mean difficulty rating score ranges from 1 to 4, where the larger the mean rating score, the higher the difficulty. When considering the whole group of students, nine topics out of 21 were perceived as significantly more difficult than the other topics. Protein synthesis, DNA Replication and Biomolecules were the most difficult, in that order. The Mann-Whitney U test revealed that the perceived level of difficulty in comprehending Biomolecules is significantly lower for students taking Chemistry compared to those not choosing the subject ($p = 0.018$). Protein Synthesis was claimed as the most difficult by Chemistry students and Biomolecules by those not studying Chemistry. DNA Replication was the second most difficult topic perceived by both groups. The Mann-Whitney U test was used to examine the effect of gender on the perceived level of difficulty in comprehending various topics. It was found that females have significantly more difficulty in comprehending Biomolecules than males ($p=0.039$). Protein synthesis was perceived as the most difficult topic by males (mean difficulty rating score = 3.14), while Biomolecules, DNA Replication and Protein synthesis were of equal difficulty for females (mean difficulty rating score = 3.00). Males and females perceived DNA Replication as equally difficult (mean difficulty rating score = 3.00). Discovering the students' study habits and perceived level of difficulty of specific topics is vital for the lecturer to offer guidance that leads to higher academic achievement.

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I. INTRODUCTION

THIS study was motivated by the poor performance in tests taken for various topics by students studying Advanced Biology in their first year. Many students at sixth-form level struggle with a number of topics studied at the Advanced level, even though they would have obtained a pass mark in their SEC a few months before. A number of students (about 19%) fail the end-of-year examination held in May and of these, about half, fail again in the September re-sit. Some students drop Biology and start afresh, hence changing completely the degree they wished to opt for when starting their course. A plethora of reasons may lead to learning difficulties, including teacher-student interactions [1], intrinsic and extrinsic motivations [2], and use of textbooks written in a foreign language [3]. The latter example applies to Maltese students studying Biology at all levels and it is commonly observed that post-secondary students find it difficult to express themselves in written assignments. Studies on the study habits, perception of topic difficulty and academic performance in Maltese post-secondary students is lacking. This study tries to fill this gap.

Study habit refers to predispositions which students have developed towards private readings through a period of time [4]. Knowledge about the study habits of students early on in their course is vital to make them aware that alternative study habits exist that might result in better understanding and retention of subject details. A widespread practice amongst Maltese students studying Biology at SEC level is reading their notes and many retain it at an Advanced level. Positive academic performance is a function of proper study habits and skills.

II. PURPOSE OF RESEARCH

This study was conducted:

1. To discover the study habits of the class investigated and if any gender differences exist.
2. To identify topics in biology perceived to be difficult to learn by post-secondary school students in their first-year.
3. To find out if those students studying Chemistry at the Advanced-level found the same topics equally difficult as those studying 'Other' subjects.
4. To establish the effect of gender on the perception of learning difficulties in post-secondary school students in

biology.

5. To find out if those students obtaining a good grade in their SEC Biology got better assessment marks at the end of their first year studying at the Advanced-level.

III. METHODOLOGY

The study was conducted with first-year post-secondary students (15-16 year olds) attending a state institution. The sample was composed of 23 students (16 taking Chemistry and seven taking some 'Other' subjects at Advanced Level, including Home-Economics and a Language). The cohort comprised seven males (six taking Chemistry) and 16 females (10 taking Chemistry). Data was collected during the last lecture at the end of their first year in May 2016.

The questionnaire was anonymous and was constructed by the authors. It was divided into two sections. In Section A, students were asked to provide information regarding gender, grade obtained at SEC level, and study habits. In Section B, students were asked to rate the level of difficulty they encountered in each of the 20 topics covered in their first year of studying Biology at the Advanced Level. The questionnaire was based on a four-point Likert scale ranging from 1 to 4, where 1 corresponds to 'easy', 2 to 'moderate', 3 to 'difficult' and 4 to 'very difficult'. The 21 Biology topics rated by the students are shown in Fig. 3.

The mean assessment mark for each student was computed by averaging the homework and test marks obtained in three semesters.

SPSS version 24 was used to analyse the data and a 0.05 level of significance was adopted in all the statistical tests carried out.

IV. RESULTS

A. Study Habits Employed by Biology Advanced-Level Students

Fig. 1 shows that the most widespread type of study habit

employed by the students was 'Writing notes on each topic' (73.9%), and the least (17.4%) was 'Writing notes for some topics'. Almost half of the group (47.8%) claimed that they 'Studied regularly'; while fewer (30.4%) stated that they 'Studied only for a test'. The percentage of students who disclosed to 'Use the same method as O-Levels' when studying was (43.5%). More students (43.5%) 'Read both notes and books' than those who 'Read only notes' (39.1%).

The Chi squared test displays no significant gender bias in the study habits adopted by male and female students ($\chi^2(6) = 5.873$, P-value = 0.438). Fig. 2 shows that 'Reading both notes and textbooks' was the most common method adopted by males (71.4%, n = 7), whereas 'Writing notes on each topic' was that mostly used by females (81.3%).

B. Difficulty Rating in Biology Advanced-Level Topics

The Friedman test is used to compare the mean difficulty rating scores provided for the difficulty of 21 topics displayed in Fig. 3. The mean difficulty rating score ranges from 1 to 4, where 1 corresponds to 'easy' and 4 to 'very difficult'. The null hypothesis specifies that the mean difficulty rating score varies marginally between the topics and is accepted if the P value exceeds the 0.05 level of significance. The alternative hypothesis specifies that the mean difficulty rating scores vary significantly between the topics and is accepted if the P value is less than 0.05. The mean difficulty rating score provided for Protein Synthesis (3.04) is the largest, indicating the most difficult topic. This is followed by Replication (3.00), and Biomolecules (2.74). The mean difficulty rating score provided to Microscopy (1.48) is the smallest, indicating least difficult topic. The result of the Friedman test ($\chi^2(20) = 119.39$, $p < 0.001$) shows a P-value less than the 0.05 level of significance indicating that some topics are significantly more difficult than others. The first two topics are significantly more difficult than the last 12 displayed in Fig. 3.

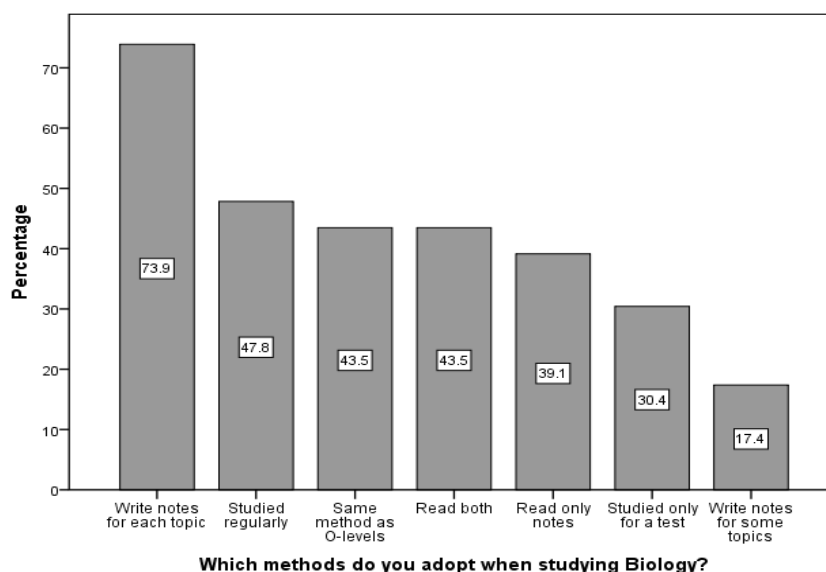


Fig. 1 The percentage of students adopting seven types of study habit (n = 23)

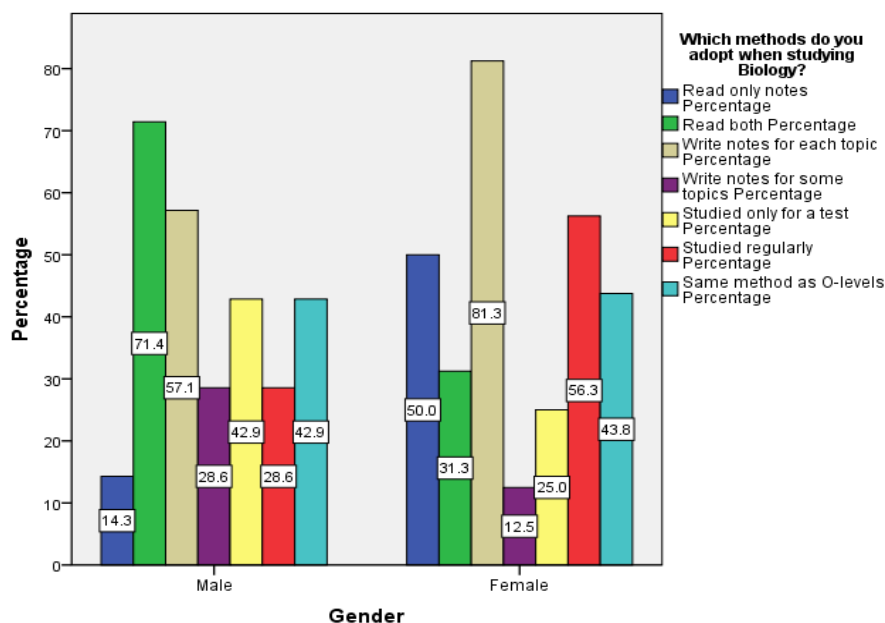


Fig. 2 The percentage of male and female students making use of each type of study habit

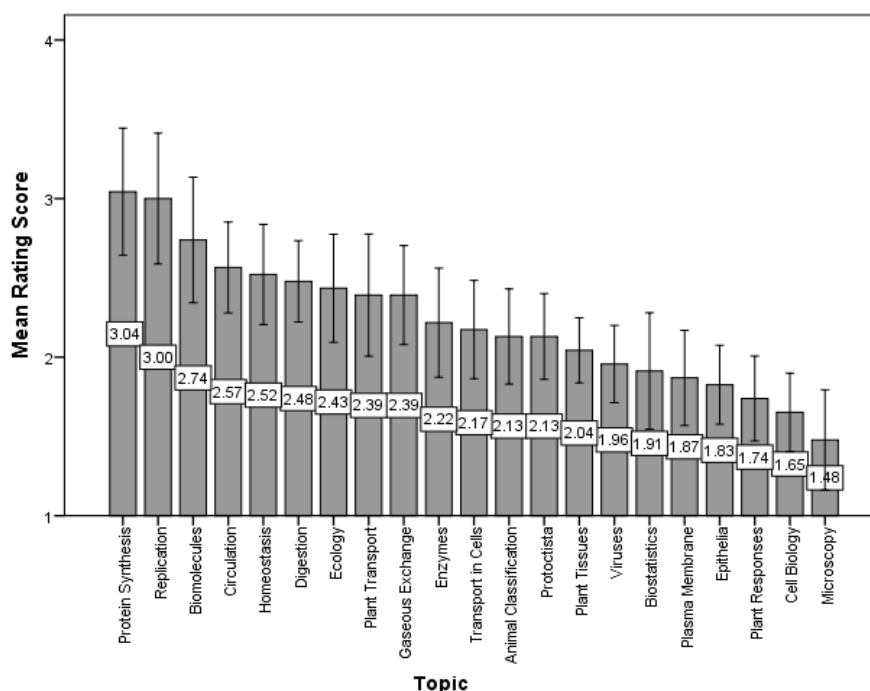


Fig. 3 The mean difficulty rating score and 95% confidence intervals for the 21 Advanced Biology topics covered during the first year when considering the whole group

C.Topic Difficulty Rating and the Second Advanced-Level Subject Studied

Table I shows that Chemistry students found Protein Synthesis most difficult because it has the highest mean difficulty rating score (3.25), followed by Replication (3.13), Digestion (2.63) and Circulation (2.63). These students found Microscopy as the easiest topic because the mean difficulty rating score (1.38), was the lowest. This is preceded by Cell Biology (1.63), Plant Responses and Biostatistics (both 1.75) and Epithelia (1.81). Other students, not taking Chemistry

found Biomolecules as the most difficult topic as it has the highest mean difficulty rating score (3.43), followed by Replication (2.71), Protein Synthesis and Homeostasis (2.57). These students found Microscopy, Cell Biology, Plasma Membranes and Plant Responses as the easiest topics, with a mean difficulty rating score of 1.71. Replication is the second most difficult topic for both Chemistry students and those who study 'Other' subjects at an Advanced-level (Fig. 4). The Mann-Whitney U test revealed that the perceived level of difficulty of Biomolecules varies significantly between the two groups (Table I).

TABLE I
MEAN DIFFICULTY RATING SCORE, STANDARD DEVIATION AND P-VALUE FOR
THE 21 ADVANCED BIOLOGY TOPICS COVERED DURING THE FIRST YEAR,
CLUSTERED BY SUBJECT GROUPS (* - SIGNIFICANT)

Topic	Group	Sample Size	Mean	Std. Dev.	P-value
Plant Tissues	Chemistry	16	2.13	0.342	0.413
	Other	7	1.86	0.690	
Biomolecules	Chemistry	16	2.44	0.892	0.018*
	Other	7	3.43	0.535	
Enzymes	Chemistry	16	2.13	0.719	0.535
	Other	7	2.43	0.976	
Replication	Chemistry	16	3.13	0.885	0.452
	Other	7	2.71	1.113	
Protein Synthesis	Chemistry	16	3.25	0.775	0.175
	Other	7	2.57	1.134	
Plant Transport	Chemistry	16	2.38	1.025	0.535
	Other	7	2.14	1.069	
Plant Responses	Chemistry	16	1.75	0.683	1.000
	Other	7	1.71	0.488	
Ecology	Chemistry	16	2.50	0.730	0.579
	Other	7	2.29	0.951	
Homeostasis	Chemistry	16	2.50	0.730	0.974
	Other	7	2.57	0.787	
Biostatistics	Chemistry	16	1.75	0.775	0.198
	Other	7	2.29	0.951	
Microscopy	Chemistry	16	1.38	0.719	0.308
	Other	7	1.71	0.756	
Cell Biology	Chemistry	16	1.63	0.500	0.922
	Other	7	1.71	0.756	
Epithelia	Chemistry	16	1.81	0.655	0.820
	Other	7	1.86	0.378	
Plasma Membrane	Chemistry	16	1.94	0.772	0.579
	Other	7	1.71	0.488	
Transport in Cells	Chemistry	16	2.06	0.772	0.341
	Other	7	2.43	0.535	
Gaseous Exchange	Chemistry	16	2.38	0.806	0.922
	Other	7	2.43	0.535	
Digestion	Chemistry	16	2.63	0.619	0.118
	Other	7	2.14	0.378	
Circulation	Chemistry	16	2.63	0.719	0.492
	Other	7	2.43	0.535	
Viruses	Chemistry	16	2.00	0.632	0.671
	Other	7	1.86	0.378	
Protoctista	Chemistry	16	2.19	0.655	0.579
	Other	7	2.00	0.577	
Animal Classification	Chemistry	16	2.19	0.655	0.624
	Other	7	2.00	0.816	

D. Gender Differences and Topic Difficulty Rating

The Mann-Whitney U test was also used to examine the effect of gender on the perceived level of difficulty of the various topics. It was found that the perceived level of difficulty in Biomolecules varied significantly between the two genders ($p = 0.039$) (Table II). Females found the topic more difficult (mean difficulty rating score = 3.00), as opposed to males (mean difficulty rating score = 2.14). Replication was perceived as equally difficult by the two genders (mean difficulty rating score = 3.00). Protein synthesis was perceived as the most difficult topic by males (mean difficulty rating score = 3.14), while Biomolecules, Replication and Protein

synthesis were equally difficulty for females (mean difficulty rating score = 3.00).

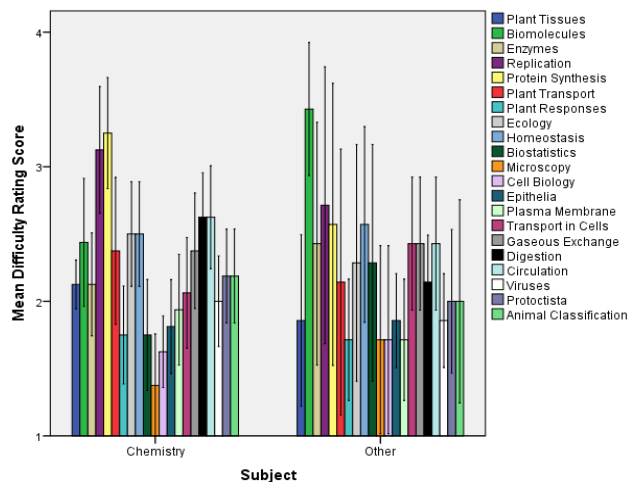


Fig. 4 Mean difficulty rating score and 95% confidence intervals for the 21 Advanced Biology topics covered during the first year, clustered by subject groups

E. Study Habit and Mean Assessment Marks

Fig. 5 shows that those students 'Reading both notes and textbooks' and 'Studying regularly' obtained the highest assessment marks at the end of their course, 64.6% and 63.91%, respectively. The One-Way ANOVA test shows no significant difference in the mean assessment marks at the end of the first year course between the study habits of students investigated (P -value = 0.231). Students who 'Studied only for a test' attained the lowest mean assessment mark, 54.29%.

F. SEC Grade and Mean Assessment Marks

The higher the grade obtained at SEC level, the higher the percentage assessment mark awarded at the end of the first year (Table III, Fig. 6). The One-Way ANOVA test shows that the mean assessment mark obtained at the end of the first year course varied significantly between the grades obtained at SEC Level (P -value < 0.001). Those obtaining a SEC grade of 2 and 3 got the highest mean assessment of 68.33% and 66.9%, respectively. The largest drop in the mean assessment mark was between those obtaining a SEC grade of 3 to 4 (11.37%), followed by those obtaining a SEC grade 4 to 5 (8.75%).

V. CONCLUSIONS AND IMPLICATIONS

The difficulty of a topic as perceived by students plays a major role in their ability and willingness to learn it [5]. Irrespective of how easy a teacher sees and declares it to be, a student's perception of the topic's difficulty will determine the learning of it.

Knowing that Protein synthesis, DNA Replication and Biomolecules were the most difficult, in that order, the teacher may choose not to explain them in tandem. A topic with a high level of difficulty perception may be followed by a relatively easy one to give time to the student to grasp the one requiring more commitment. Discovering the students' study habits and perceived level of difficulty of specific topics is vital for the

lecturer to offer guidance that leads to higher academic achievement.

TABLE II
MEAN DIFFICULTY RATING SCORE, STANDARD DEVIATION AND P-VALUE FOR THE 21 ADVANCED BIOLOGY TOPICS COVERED DURING THE FIRST YEAR, CLUSTERED BY SUBJECT GENDER (* - SIGNIFICANT)

Topic	Gender	Sample Size	Mean	Std. Dev.	P-value
Plant Tissues	Male	7	2.14	0.378	0.671
	Female	16	2.00	0.516	
Biomolecules	Male	7	2.14	0.690	0.039*
	Female	16	3.00	0.894	
Enzymes	Male	7	2.57	0.787	0.118
	Female	16	2.06	0.772	
Replication	Male	7	3.00	0.817	0.922
	Female	16	3.00	1.033	
Protein Synthesis	Male	7	3.14	0.900	0.820
	Female	16	3.00	0.966	
Plant Transport	Male	7	2.71	1.380	0.135
	Female	16	2.13	0.806	
Plant Responses	Male	7	2.00	0.817	0.341
	Female	16	1.63	0.500	
Ecology	Male	7	2.43	0.535	0.820
	Female	16	2.44	0.892	
Homeostasis	Male	7	2.57	0.535	0.769
	Female	16	2.50	0.817	
Biostatistics	Male	7	1.57	0.535	0.308
	Female	16	2.06	0.929	
Microscopy	Male	7	1.71	0.951	0.535
	Female	16	1.38	0.619	
Cell Biology	Male	7	2.00	0.577	0.118
	Female	16	1.50	0.516	
Epithelia	Male	7	2.14	0.690	0.175
	Female	16	1.69	0.479	
Plasma Membrane	Male	7	2.00	0.578	0.579
	Female	16	1.81	0.750	
Transport in Cells	Male	7	2.43	0.787	0.278
	Female	16	2.06	0.680	
Gaseous Exchange	Male	7	2.43	0.535	0.922
	Female	16	2.38	0.806	
Digestion	Male	7	2.71	0.488	0.198
	Female	16	2.38	0.619	
Circulation	Male	7	2.71	0.488	0.492
	Female	16	2.50	0.730	
Viruses	Male	7	2.00	0.577	0.871
	Female	16	1.94	0.574	
Protoctista	Male	7	2.43	0.535	0.198
	Female	16	2.00	0.632	
Animal Classification	Male	7	2.29	0.756	0.535
	Female	16	2.06	0.680	

TABLE III
MEAN ASSESSMENT MARK OBTAINED AT THE END OF THE FIRST YEAR COURSE, STANDARD DEVIATION, AND P-VALUE, CLUSTERED BY SEC GRADE

SEC Grade	N	Mean Assessment (%)	Std. Dev.	P-value
2	7	68.33	3.300	<0.001
3	7	66.90	7.539	
4	5	55.53	6.793	
5	3	46.78	8.329	

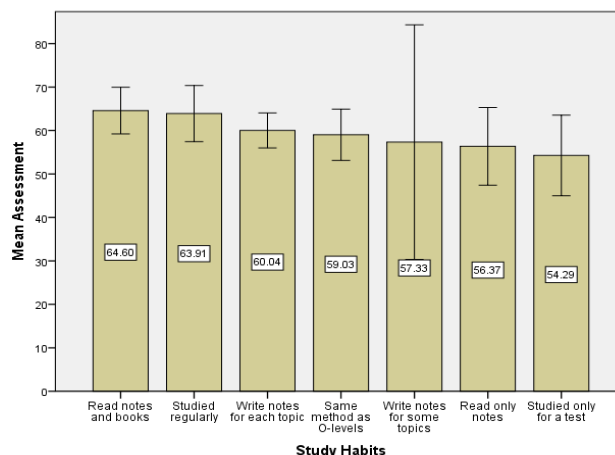


Fig. 5 Mean assessment marks obtained by Advanced Biology students at the end of the first year course and corresponding 95% confidence intervals, clustered by study habits

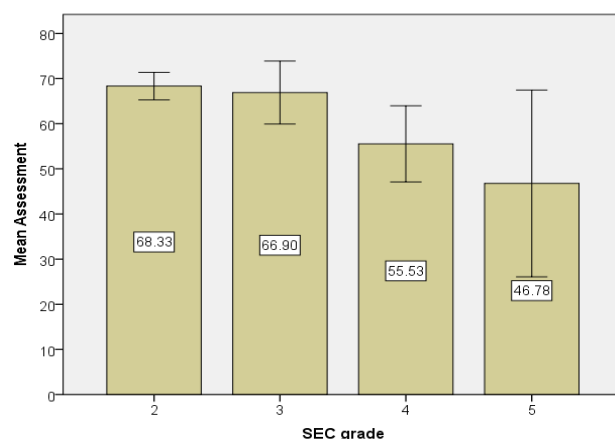


Fig. 6 Mean assessment mark obtained at the end of the first year course and 95% confidence intervals, clustered by grade obtained at SEC Level

Gender differences in study habits, approach and skills have been reported in the literature [6]. The findings in this study do not show gender differences in study habits, maybe due to the small sample size. Further research is needed in this aspect. Gender differences however, were reported on topic difficulty - females found Biomolecules more difficult than males.

Many prospective students ask advice to lecturers during the open day held at the institution regarding whether or not to take up Biology at an Advanced level even though they have not studied Chemistry at the Ordinary level. From the results obtained in this study, it may be concluded that just one topic, Biomolecules, was found challenging. This research gives lecturers confidence in their advice to students wanting to pursue studies in the medical field.

Results reported in this study revealed lower achievement by students with a SEC grade of 4 or 5, as well as those that do not study Chemistry at the Advanced level. This finding may suggest the importance of knowing this type of background information about the student at the start of the

academic year by administering a questionnaire. This may be valuable to the teacher to guide each student individually and help each one to make use of his/ her full potential. It should be noted that the majority of the students that study at the Advanced level in public institutions hold SEC grades of 4 or 5, since the rest prefer to attend elsewhere.

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